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New Data on Little-known Beetle Families and a Summary of the Project: Coleoptera of the Eastern Beskid Mts (Western Carpathians, Poland)

Artur TASZAKOWSKI[1] Natalia KASZYCA-TASZAKOWSKA[2]
Wojciech T. SZCZEPAŃSKI[3] Lech KARPIŃSKI[4]*

[1,2]Institute of Biology, Biotechnology and Environmental Protection, Faculty of Natural Sciences, University of Silesia in Katowice, Bankowa 9, 40-007 Katowice, POLAND
[3]Kościelna 34B/19, 41-103 Siemianowice Śląskie, POLAND
[4]Museum and Institute of Zoology, Polish Academy of Sciences, Wilcza 64, 00-679 Warsaw, POLAND
e-mails: [1]artur.taszakowski@us.edu.pl, [2]nkaszyca@us.edu.pl, [3]szczepanski.w@interia.pl, [4]*lkarpinski@miiz.waw.pl
ORCID IDs: [1]0000-0002-0885-353X, [2]0000-0001-5031-6167,[3]0000-0003-0858-519X, [4]*0000-0002-5475-3732

ABSTRACT

New data on the distribution of the beetles from the Eastern Beskid Mountains are given. A list of 100 species from 37 families is presented. New localities of some species rare in Poland such as *Elodes johni* Klausnitzer, 1980, *Lyctus pubescens* Panzer, 1792, *Malachius scutellaris* Erichson, 1840, *Osphya bipunctata* (Fabricius, 1775), *Peltis grossa* (Linnaeus, 1758), *Pyrochroa serraticornis* (Scopoli, 1763) and *Soronia punctatissima* (Illiger, 1794) are also given. Eight taxa were recorded in the Eastern Beskid Mts for the first time: *Agabus congener* (Thunberg, 1794), *Amphotis marginata* (Fabricius, 1781), *Dolichosoma lineare* (Rossi, 1794), *Dytiscus dimidiatus* Bergsträsser, 1778, *Glischrochilus quadrisignatus* (Say, 1835), *Ips cembrae* (Heer, 1836), *Orthoperus nigrescens* Stephens, 1829 and *Stephostethus alternans* (Mannerheim, 1844). A comprehensive summary of our entire research, which was conducted in the Eastern Beskid Mts between 1999 and 2017, is provided with an emphasis on species protected by Polish law or included in various lists of endangered species.

Key words: Biodiversity, endangered species, faunistics, primeval forest relics.

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INTRODUCTION

Beetles (Coleoptera) are the largest and the most diverse group of insects and they inhabit nearly all habitats. In Poland, they are among the richest groups in respect to the number of species. To date, more than 6000 species have been recorded in the country and new species are constantly being discovered (Biodiversity Map, 2018). Although mountainous areas only cover approx. 8% of the area of Poland, including about 6% of strictly mountain areas, they are very attractive in terms of species richness due to their huge diversity of environments, vegetation zones and climatic conditions as well as a high level of preservation (Knutelski & Tykarski, 2010). Extensive literature data show that beetles have been of considerable interest in these areas since the beginning of the 19th century. Nevertheless, the knowledge of beetles in particular mountain regions is both insufficient and very unequal. For example, the Bieszczady, Pieniny and Beskidy Mountains have been relatively well investigated; however, many of the remaining areas have not been comprehensively studied. Therefore, the currently published data only concern some groups of Coleoptera from specific regions (Knutelski & Tykarski, 2010).

An analysis of the data contained in the Catalogue of Fauna of Poland, which was conducted by Knutelski & Tykarski (2010), showed that 5120 species of beetles (approx. 85.5% of the Polish fauna) are found in the mountainous areas. Among the three main mountain ranges of Poland, the largest number of beetles (4570 species) is found in the Carpathian Mountains due to the greatest diversity of habitats. In the subregion of the Eastern Beskid Mts, approx. 3500 species have been found to date (Knutelski & Tykarski, 2010). Therefore, while the state of the knowledge on the Coleoptera fauna in this area can be considered to be relatively good, it is still quite unequal. The high number of recorded species is to a large degree the result of the intensive research conducted by Trella (e.g. 1923a; 1923b; 1925) in the environs of Przemyśl in the early 20th century. However, recently collected information on distribution of beetles in this zoogeographical region has been limited mainly to the data that were published by a group of the researchers from the Department of Zoology of the University of Silesia (e.g. Karpiński, Taszakowski, & Szczepański, 2015; Szczepański, Taszakowski, & Karpiński, 2015a; Szczepański, Taszakowski, Karpiński, & Kubusiak, 2015c; Szczepański, Taszakowski, Karpiński, & Tomecka, 2015d; Kaszyca & Taszakowski, 2017; Taszakowski, Kaszyca, & Mazur, 2017a; Taszakowski, Morawski, Szołtys, & Szczepański, 2017b; Taszakowski, Kaszyca, & Szołtys, 2018; Taszakowski, Masłowski, Karpiński, Szczepański, & Szołtys, 2019), which was gathered into a Biodiversity Map (2018). As a consequence, the area of the Low Beskid Mts can still be considered to be a “blank spot” on the map of Poland (Gil & Melke, 2017; Taszakowski et al, 2017b).

This paper is part of a series presenting the results of the faunistic research on the beetles in the Eastern Beskid Mts, which were conducted intensively in 2010-2015. Therefore, the present study aims to supplement the faunistic data on many species not included in the above-mentioned works as well as to summarise the results of the entire field research project conducted in 1999-2017.

MATERIAL AND METHODS

According to the division of Poland that is used in the Catalogue of Fauna of Poland (Burakowski, Mroczkowski, & Stefańska, 1973), the research area is located in the Eastern Beskid Mountains (Beskid Wschodni). It is a large zoogeographical region (about 8670 km^2) in south-eastern Poland (Fig. 1). In terms of the physical-geographical division of Poland (Kondracki, 2013), this region is situated in two provinces in the Carpathian megaregion - the Western Carpathians, which includes Western and Northern Subcarpathia and the Eastern Carpathians, which includes Eastern Subcarpathia. The study area did not cover the entire area of the Eastern Beskidy Mts, only a part that is located in three mesoregions - the Ciężkowickie Foothills (Pogórze Ciężkowickie), the Jasielskie Foothills (Pogórze Jasielskie), and the Low Beskids (Beskid Niski). In this paper, we use the names of the regions that are used in the Catalogue of Fauna of Poland when we refer to our data in the Eastern Beskid Mountains. However, we treated separately the Low Beskids, which is a mountain range that forms a transition zone between the Eastern and Western Beskids (Kondracki, 2013). In this way, we wanted to highlight the specificity of the fauna of the region, which is at a relatively low altitude and has many mountain passes. Recent studies have shown that they constitute a very important Transcarpathian route (Ondavian migratory route) for the migration of small fauna from the south to the north, between the Pannonian Basin, which includes the Ondava Upland and the drainage basin of the San and Wisłoka Rivers (Taszakowski & Gorczyca, 2018).

Research plots (Fig. 1) were selected in the following locations (in alphabetical order): Bednarka [EA20], Dobrynia [EV39], Libusza [EA10], Lipinki [EA20], Lisów [EA21], Małastów [EV18], Nowy Żmigród [EV39], Rozdziele [EV19], Wójtowa [EA20], Załęże [EV39] and in the Low Beskids: Bartne [EV28, EV29], Bednarka [EV29], Blechnarka [EV17], Folusz [EV29], Jaśliska [EV57], Kąty [EV39], Krempna [EV38], Mrukowa [EV39], Nieznajowa [EV28], and Wysowa-Zdrój [EV17].

The material was primarily collected during the growing seasons. Due to the mild winters, it was also possible to sample overwintering insects. The most effective standard methods for collecting beetles such as attracting them to artificial light sources (with yellow and ultraviolet light), shaking them down from trees and shrubs into an entomological umbrella, sweep netting (grasslands and ecotone zones), sifting plant litter using an entomological sieve and Winkler-Moczarski eclector, and analyses of the immature stages and feeding galleries found in inhabited wood material were used during the field research. The beetles were collected in different plant communities [the nomenclature after Matuszkiewicz (2013)] (Fig. 2), e.g. Carpathian alder forest (*Alnetum incanae*), Carpathian beech forest (*Dentario glandulosae-Fagetum*) and its bordering shrub vegetation (*Rhamno-Prunetea*) (mainly in the Low Beskids), linden-oak-hornbeam forest (*Tilio-Carpinetum*) (Bednarka env.), subxerothermic plant communities (Dobrynia env.) and from meadows, pastures or shrubs that were slowly overgrown.

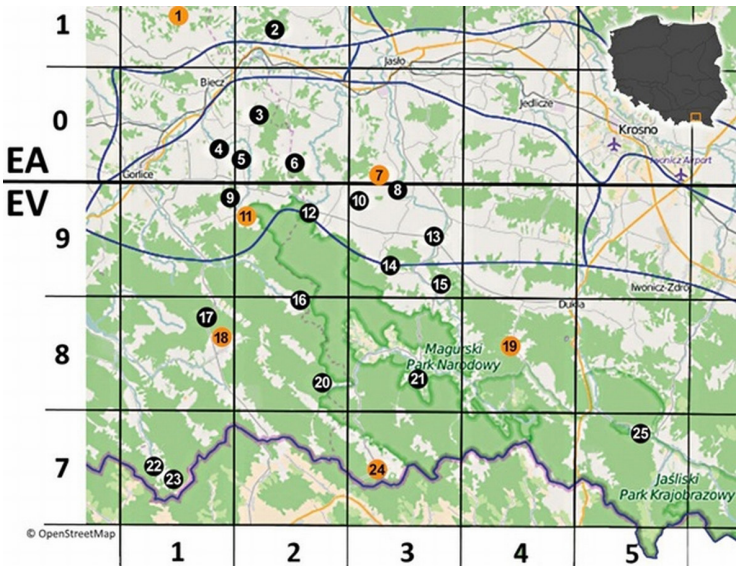

Fig. 1. Research sites: 1-Ołpiny, 2-Lisów, 3-Wójtowa, 4-Libusza, 5-Lipinki, 6-Bednarka (a), 7-Wola Dębowiecka, 8-Załęże, 9-Rozdziele, 10-Dobrynia, 11-Wapienne, 12-Bednarka (b) and Folusz, 13-Nowy Żmigród, 14-Mrukowa, 15-Kąty, 16-Bartne, 17-Małastów, 18-Gładyszów, 19-Chyrowa, 20-Nieznajowa, 21-Krempna, 22-Wysowa-Zdrój, 23-Blechnarka, 24-Ożenna, and 25-Jaśliska. Black circles - the sites on which the material used in this article was collected, orange circles - the sites on which the material was presented only in previous publications from the series. Lines and numbers of black color constitute the UTM grid, blue lines represent the boundaries of the mesoregions; © authors OpenStreetMap.

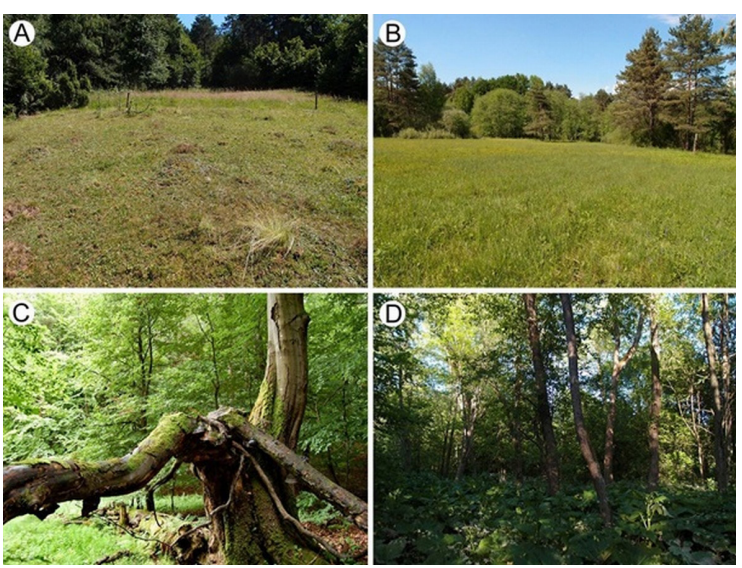

Fig. 2. Characteristic habitats; A-subxerothermic plant communities in Bartne; B-wet meadow in Wysowa-Zdrój; C-Carpathian beech forest in Bartne; D-Carpathian alder forest in Jaśliska.

The nomenclature for the beetles was adopted from the Catalogue of Palearctic Coleoptera (Löbl & Smetana, 2003; 2004; 2006; 2007; 2008; 2010; 2011; 2013). The specimens are preserved in the collections of the Institute of Biology, Biotechnology and Environmental Protection, Faculty of Natural Sciences, University of Silesia in Katowice (IoBUS), the Upper Silesian Museum in Bytom (USMB) and in the collections of the authors.

The specimens were imaged using a Leica M205C stereo microscope with a Leica DFC495 digital camera and the Leica application suite 4.9.0 software.

The potential number of species was estimated using the Chao1 formula (Chao & Bunge, 2002; Gotelli & Colwell, 2011).

$$S_{Chao1} = S_{obs} + (f_1^2 / 2f_2)$$

Where:

S_{Chao1} - potential number of species,

S_{obs} - empirical number of species,

f_1 - number of species represented by one specimen in the collection,

f_2 - number of species represented by two specimens in the collection.

RESULTS

The following list contains 100 species that belong to 37 beetle families. The species that were recorded in the Eastern Beskid Mountains for the first time are indicated by an asterisk (*).

Adephaga Schellenberg, 1806

Dytiscidae Leach, 1815

***Acilius canaliculatus* (Nicolai, 1822)**

Wysowa-Zdrój [EV17], 2007, 1 ex.

***Agabus congener* (Thunberg, 1794) ***

Libusza [EA10], 22.07.2006, 1 ex.

The species is widely distributed in the northern part of the Holarctic. In Poland, it occurs throughout the country in both the lowlands and mountains. Although *Agabus congener* primarily inhabits small water reservoirs that are overgrown with grasses and sedges, it is sometimes also found in the coastal zone of lakes and ponds (Burakowski, Mroczkowski, & Stefańskal, 1976).

***Agabus melanarius* Aubé, 1837**

Libusza [EA10], 22.07.2006, 1 ex.; Wysowa-Zdrój [EV17] 01.05.2016, 1 ex.

***Dytiscus marginalis* Linnaeus, 1758**

Lipinki [EA20], 2007, 2 exx.

***Dytiscus dimidiatus* Bergsträsser, 1778 ***

Lipinki [EA20], 2009, 2 exx.

This is a common species that is distributed over almost whole Europe, Asia Minor, Transcaucasia, Iran, Syria and Central Asia. In Poland, it is known from numerous scattered localities. It occurs in various types of waters, both standing and flowing, that are abundantly overgrown with plants (Burakowski et al, 1976).

***Ilybius fuliginosus* (Fabricius, 1792)**

Załęże [EV39], 07.08.2009, 1 ex.

***Platambus maculatus* (Linnaeus, 1758)**

Libusza [EA10], 10.08.2009, 1 ex.

***Rhantus suturalis* (Macleay, 1825)**

Załęże [EV39], 07.08.2009, 2 exx.

Polyphaga Emery, 1886

Elateriformia Crowson, 1960

Scirtoidea Fleming, 1821

Scirtidae Fleming, 1821

***Contacyphon palustris* C.G. Thomson, 1855**

Libusza [EA10], scrubs (*Rhamno-Prunetea*), 15.05.2013, 4 exx.; Nieznajowa [EV28], at light (UV), 26.07.2015, 1 ex.

***Contacyphon coarctatus* Paykull, 1799**

Bartne [EV28], scrubs, 11.07.2013, 2 exx.

***Elodes minuta* (Linnaeus, 1767)**

Libusza [EA10], scrubs, 15.05.2013, 1 ex.

***Elodes johni* Klausnitzer, 1975**

Bartne [EV29], scrubs, 11.07.2013, 2 exx.

Elodes johni was relatively recently described from Germany and to date, it is only known from a few countries, primarily in Central Europe (Burakowski, Mroczkowski & Stefańska, 2000). In Poland, it was recorded for the first time from the Bieszczady Mts by Borowiec and Kania (1996). In the past, it was probably misidentified with the common *Elodes minuta* (Linnaeus, 1767). Currently, after the revision of specimens, it is recorded from four zoogeographical regions. In the Eastern Beskidy Mts, it is known from several localities (Biodiversity Map, 2018). The species is found on banks of streams and at forest edges (Burakowski et al, 2000).

***Microcara testacea* (Linnaeus, 1767)**

Blechnarka [EV17], olszyna, 21.05.2014, 1 ex.

***Scirtes hemisphaericus* (Linnaeus, 1767)**

Libusza [EA10], at light, 08.08.2013, 1 ex.

Byrrhoidea Latreille, 1804

Byrrhidae Latreille, 1804

***Byrrhus pilula* (Linnaeus, 1758)**

Dobrynia [EV39], subxerothermic plant community, 12.05.2015, 1 ex.

***Cytilus sericeus* (Forster, 1771)**

Bednarka [EA20], linden-oak-hornbeam forest (*Tilio-Carpinetum*) 12.05.2015, 2 exx.

Elateroidea Leach, 1815

Omalisidae Lacordaire, 1857

***Omalisus fontisbellaquaei* Geoffroy, 1785**

Nieznajowa [EV28], scrubs, 26.07.2015, 1 ex.

The species was previously recorded also in two other localities (Szczepański, Karpiński & Taszakowski, 2013).

Lampyridae Latreille, 1817

***Lamprohiza splendidula* (Linnaeus, 1767)**

Nieznajowa [EV28], at light (UV), 26.07.2015, 1 ex.

***Phosphaenus hemipterus* (Goeze, 1777)**

Jaśliska [EV57], scrubs (*Rhamno-Prunetea*), 06.06.2015, 1 ex.

Both firefly species were previously recorded in Szczepański & Karpiński (2013) and Szczepański et al (2015d).

Bostrichiformia Forbes, 1927

Bostrichoidea Latreille, 1802

Dermestidae Latreille, 1804

***Anthrenus scrophulariae* (Linnaeus, 1758)**

Libusza [EA10], scrubs, 15.05.2013, 2 exx.

***Attagenus pellio* (Linnaeus, 1758)**

Libusza [EA10], 2008, 1 ex.

***Dermestes laniarius* Illiger, 1801**

Libusza [EA10], 03.06.2010, 1 ex.; 20.07.2013, 1 ex.

***Dermestes lardarius* Linnaeus, 1758**

Libusza [EA10], 2008, 1 ex.; riverbank, 29.04.2013, 1 ex.

***Dermestes murinus* Linnaeus, 1758**

Lipinki [EA20], subxerothermic plant community, 21.04.2014, 1 ex.

Bostrichidae Latreille, 1802

***Lyctus pubescens* Panzer, 1792**

Libusza [EA10] 2006, 1 ex.

A rare species, which is distributed in southern and central Europe, the Caucasus and Asia Minor (Burakowski, Mroczkowski, & Stefańska, 1986a). In Poland, it is known from nine zoogeographical regions (Biodiversity Map, 2018). In the Eastern Beskidy Mts, it is known only from the Przemyśl env. (Trella, 1925). It inhabits trees and especially prefers oaks, which mainly grow in wet and shady places. Adults lead a secretive way of life by hiding in wood crevices during the day. However, specimens have sometimes been found on freshly barked or injured trees (Burakowski et al, 1986a).

Ptinidae Latreille, 1802

***Ptilinus pectinicornis* (Linnaeus, 1758)**

Libusza [EA10], woodshed, 2006, 3 exx.

Cucujiformia Lameere, 1938

Lymexyloidea Fleming, 1821

Lymexylidae Fleming, 1821

***Elateroides dermestoides* (Linnaeus, 1761)**

Libusza [EA10], 2007, 1 ex.; Wysowa-Zdrój [EV17], scrubs (*Rhamno-Prunetea*), 18 May 2013, 2 exx.; scrubs (*Rhamno-Prunetea*), shaken down, 01.05.2014, 2 exx.; meadow, 01.05.2014, 2 exx.

Cleroidea Latreille, 1802

Trogossitidae Latreille, 1802

***Peltis grossa* (Linnaeus, 1758) (Fig. 3A)**

Jaśliska [EV57], Carpathian alder forest (*Alnetum incanae*), 06.06.2015, 1 ex.

The species is widespread in the forested areas of Fennoscandia, Karelia and Siberia and in the primeval forests of central and southern Europe. In Poland, it is rarely

recorded and is primarily known from the southern part of the country (Burakowski et al, 1986a). Recent records come from the Białowieża Primeval Forest (Kubisz & Szwałko, 1991), the Świętokrzyskie Mts (Byk, 2007), Roztocze (Papis & Mokrzycki, 2015) and the Bieszczady Mts (Holly, 2016). In the Eastern Beskidy Mts, it is only known from the Przemyśl env. (Trella, 1923b).

Peltis grossa is a relatively rare saproxylic beetle. Its larvae develop in the soft, decaying wood of standing or fallen trees (both coniferous and deciduous) that are infested with fungi (Kolibáč, 2013; Procházka, Kment, Németh, & Kolibáč, 2017). The species is considered to be an indicator species of natural forest habitats (Müller et al, 2005).

Cleridae Latreille, 1802

***Thanasimus formicarius* (Linnaeus, 1758)**

Libusza [EA10], 20.06.2005, 1 ex.; scrubs, 04.06.2015, 1 ex.; dead wood, 15.05.2013, 2 exx.; Wysowa-Zdrój [EV17], wood pile, 02.05.2014, 2 exx.

***Tillus elongatus* (Linnaeus, 1758)**

Libusza [EA10], 20.06.2005, 1 ex.

***Trichodes apiarius* (Linnaeus, 1758)**

Bartne [EV29], meadow, 09.07.2013, 1 ex.; Carpathian beech forest (*Dentario glandulosae-Fagetum*), 10.07.2013, 1 ex.; Bednarka [EV29], Carpathian beech forest (*Dentario glandulosae-Fagetum*), 29 .07.2014, 2 exx.; Libusza [EA10], scrubs, 17.08.2012, 1 ex.; 20.06.2005, 1 ex.; 04.08.2009, 1 ex.; Wysowa-Zdrój [EV17], scrubs, 03.08.2011, 1 ex.; Carpathian beech forest (*Dentario glandulosae-Fagetum*), 11.07.2011, 1 ex.

Dasytidae de Castelnau, 1840

***Dasytes caeruleus* (De Geer, 1774)**

Bednarka [EA20], linden-oak-hornbeam forest (*Tilio-Carpinetum*), 16.05.2013, 1 ex.; Dobrynia [EV39], subxerothermic plant community, 22.07.2013, 1 ex.

***Dasytes fusculus* (Illiger, 1801)**

Dobrynia [EV39], subxerothermic plant community, 16.05.2013, 1 ex.; Libusza [EA10] meadow, 20.05.2014, 1 ex.; dead wood, 30.04.2014, scrubs, 20.04.2014., 1 ex.; Lipinki [EA20], subxerothermic plant community, 21.04.2014, 1 ex.; Wysowa-Zdrój [EV17] scrubs, 17.05.2013, 1 ex., 21.05.2014 1 ex.

***Dasytes niger* (Linnaeus, 1761)**

Dobrynia [EV39], subxerothermic plant community, 16.05.2013, 1 ex. Libusza [EA10], scrubs, 10.06.2013, 1 ex.; Mrukowa [EV39], meadow, 13.06.2013, 1 ex.; Wysowa-Zdrój [EV17], wet meadow, 27.07.010, 1 ex.

***Dolichosoma lineare* (Rossi P., 1794) ***

Bartne [EV29], meadow, 11.07.2013, 1 ex.; scrubs, 10.07.2013, 1 ex.; Libusza [EA10], scrubs, 12.06.2013, 1 ex.; subxerothermic plant community, 15.06.2013, 1 ex.; Nowy Żmigród [EV39], meadow, 19.05.2013, 3 exx.

The species is widespread in Europe; it reaches as far as Transbaikal and Siberia to the east. In Poland, it is probably distributed throughout the entire country, but it still has not been recorded from several regions (Burakowski et al, 1986a). Adults usually occur in open areas such as grasslands or wastelands where they are frequently observed.

Malachiidae Fleming, 1821

***Anthocomus fasciatus* (Linnaeus, 1758)**

Libusza [EA10], herbs community, 16.06.2013, 1 ex.

***Axinotarsus marginalis* (Laporte, 1840)**

Libusza [EA10], meadow, 12.08.2014, 1 ex.

***Axinotarsus ruficollis* (A.G. Olivier, 1790)**

Lipinki [EA20], subxerothermic plant community,12.06.2013, 1 ex.

***Charopus flavipes* (Paykull, 1798)**

Bednarka [EA20], linden-oak-hornbeam forest (*Tilio-Carpinetum*), 13.06.2014, 1 ex.; Dobrynia [EV39], subxerothermic plant community, 16.06.2013, 1 ex.

***Malachius bipustulatus* (Linnaeus, 1758)**

Bednarka [EA20], linden-oak-hornbeam forest (*Tilio-Carpinetum*), 13.06.2013, 1 ex.; Libusza [EA10], meadow, 10.06.2013, 1 ex.; meadow, 15.05.2013, 1 ex.; Mrukowa [EV39], scrubs, 13.06.2013, 1 ex.; Wójtowa [EA20], scrubs (*Rhamno-Prunetea*), 16.05.2013, 1 ex.; Wysowa-Zdrój [EV17], wet meadow, 01.05.2014, 1 ex.; scrubs, 23.05.2011, 1 ex.

***Malachius scutellaris* Erichson, 1840 (Fig. 3B)**

Libusza [EA10]; scrubs, 15.05.2013, 2 exx.; Wysowa-Zdrój [EV17], scrubs, 17.05.2013, 1 ex.

This in one of the rarest representatives of the genus *Malachius* Fabricius, 1775 in Poland. Until 1986, it was only known from six regions: the Baltic Coast, Lower Silesia, the Kraków-Wieluń Upland, the Sandomierska Lowland, the Western Beskidy Mts and the Pieniny Mts (Burakowski et al, 1986a). In the Eastern Beskidy Mts, it was recorded by H. Szołtys for the first time in 1984 (Biodiversity Map, 2018). In the neighbouring region - the Western Beskidy Mts - its presence was recently confirmed by Kubisz (1990) and Szarfaniec, Szarfaniec, & Mazur (2010), and later, it was collected in the Białowieża Primeval Forest (Borowiec, Kania, & Wanat, 1992) and the Mazovian Lowland (Marczak, Borowski, & Jędryczkowski, 2016) for the first time.

Malachius scutellaris is mainly distributed in the central and eastern part of Europe. In Asia, it was only recorded in Syria (Mayor, 2007). The species is considered to be rare in its entire range (Szarfaniec et al, 2010). Its biology is still poorly known. The larvae are predators and prey on immature stages of other insects. Adults are palynivores and they prefer warm slopes that are overgrown by *Barbarea* spp. and *Isatis* spp. (Kolibáč, Majer, & Švihla, 2005; Szarfaniec et al, 2010).

Cucujoidea Latreille, 1802

Kateretidae Erichson, 1846

***Brachypterus urticae* (Fabricius, 1792)**

Bednarka [EV29], scrubs, 11.07.2013, 1 ex.

***Kateretes pedicularius* (Linnaeus, 1758)**

Rozdziele [EV19], scrubs, 01.05.2013, 1 ex.

Nitidulidae Latreille, 1802

***Amphotis marginata* (Fabricius, 1781) ***

Libusza [EA10], sieve analysis, 22.03.2014, 1 ex.

The species is widespread in Europe. In Poland, it has rarely been collected and is known from 14 zoogeographical regions (Lasoń & Bidas, 2010; Biodiversity Map, 2018).

Amphotis marginata is a myrmecophilous species. Adults lead a cryptic life in their relationship with the ant species - *Lasius fuliginosus* (Latreille, 1798). The beetles use tactile cues to mimic the begging behaviour of ants and, if an ant is fooled, this will solicit the regurgitation of a liquid food drop that is offered to the beetle (Hölldobler & Wilson, 1990).

***Cychramus luteus* (Fabricius, 1787)**

Wysowa-Zdrój [EV17], meadow, 23.07.2010, 1 ex.

***Cyllodes ater* (Herbst, 1792)**

Wysowa-Zdrój [EV17], 27.08.2009, 1 ex.

***Glischrochilus quadrisignatus* (Say, 1835) ***

Bednarka [EV29], Carpathian beech forest (*Dentario glandulosae-Fagetum*), 23.07.2013, 1 ex.

The species is widespread throughout North America, where it is listed as a pest on fruit plantations and corn crops. It was brought to Europe with imported vegetables and fruits in the middle of the 20th century. Since then, its range is gradually increasing and it is currently distributed in most European countries. In Poland, the species was recorded in 1990 (Lasoń, 1999b) for the first time, and currently, it is known from 12 zoogeographical regions (Biodiversity Map, 2018).

In natural conditions, it mainly feeds on the fermenting sap of deciduous tree trunks and on decaying mushrooms. The species has become adapted to the environments near human settlements (Lasoń, 1999a).

***Omosita depressa* (Linnaeus, 1758)**

Bednarka [EA20], linden-oak-hornbeam forest (*Tilio-Carpinetum*), 16.05.2013, 2 exx.

***Pocadius adustus* Reitter, 1888**

Lipinki [EA20], subxerothermic plant community, 24.05.2014, 1 ex.

***Pocadius ferrugineus* (Fabricius, 1775)**

Dobrynia [EV39], subxerothermic plant community,12.05.2015, 1 ex.

***Soronia grisea* (Linnaeus, 1758)**

Libusza [EA10], dead wood, 22.10.2013, 1 ex.

***Soronia punctatissima* (Illiger, 1794) (Fig. 3C)**

Libusza [EA10], 2006, 1 ex.

Although the species is widespread in Europe, it has rarely been collected in Poland. It is known from single plots in 13 zoogeographical regions (Burakowski, Mroczkowski & Stefańska, 1986b; Lasoń, 1997; 1999a; Lasoń & Bidas, 2010; Lasoń & Miłkowski, 2011), which are mainly located in the southern and western parts of the country. The species is usually found under wet and rotten bark soaked by leaking tree sap or in similar habitats such as composts (Burakowski et al, 1986b).

Silvanidae Kirby, 1837

***Uleiota planatus* (Linnaeus, 1761)**

Blechnarka [EV17], wood pile, 20.08.2010, 1 ex.; Libusza [EA10], dead wood, 30.04.2013, 1 ex.; dead wood, 15.05.2013, 2 exx.

***Silvanus bidentatus* (Fabricius, 1792)**

Libusza [EA10], dead wood, 30.04.2013, 1 ex.; scrubs, 15.05.2013, 1 ex.

Cucujidae Latreille, 1802

***Cucujus cinnaberinus* (Scopoli, 1763)**

Bednarka [EV29], Carpathian beech forest (*Dentario glandulosae-Fagetum*), under bark of *Acer pseudoplatanus*, 01.03.2014, 1 ex.

Phalacridae Leach, 1815

***Olibrus bicolor* (Fabricius, 1792)**

Libusza [EA10], scrubs, 15.05.2013, 1 ex.

Erotylidae Latreille, 1802

***Tritoma bipustulata* Fabricius, 1775**

Wysowa-Zdrój [EV17], 30.04.2014, 1 ex.

Byturidae Jacquelin du Val, 1858

***Byturus ochraceus* (Scriba, 1790)**

Bednarka [EV29], linden-oak-hornbeam forest (*Tilio-Carpinetum*), 16.05.2013, 1 ex.; Libusza [EA10], meadow, 16.06.2013, 1 ex.; riverbank, 29.04.2013, 1 ex., scrubs, 12.06.2014, 1 ex.

***Byturus tomentosus* (De Geer, 1774)**

Bartne [EV29], Carpathian beech forest (*Dentario glandulosae-Fagetum*), 10.07.2013, 1 ex.; Bednarka [EV29], linden-oak-hornbeam forest (*Tilio-Carpinetum*), 16.05.2013, 1 ex.; Libusza [EA10], riverbank, 29.04.2013, 1 ex.; scrubs, 15.05.2013, 2 exx.; scrubs, 10.06.2013, 1 ex.; 20.07.2013, 1 ex.; Rozdziele [EV19], scrubs, 01.05.2013, 1 ex.; Wysowa-Zdrój [EV17], meadow, 02.05.2014, 1 ex.

Endomychidae Leach, 1815

***Endomychus coccineus* (Linnaeus, 1758)**

Bartne [EV29], Carpathian beech forest (*Dentario glandulosae-Fagetum*), 9.07.2013, 2 exx.; scrubs, 11.07.2013, 1 ex.; Libusza [EA10], 08.08.2008, 1 ex.; 14.08.2009, 3 exx.; woodshed, 13.08.2014, 2 exx.

***Mycetaea subterranea* (Fabricius, 1801)**

Libusza [EA10], woodshed, 26.12.2013, 7 exx.

Corylophidae LeConte, 1852

***Orthoperus nigrescens* Stephens, 1829 ***

Lisów [EA21], 15.08.2014, 1 ex.

This rare species is mainly distributed in northern Europe, where it reaches the Asian part of Turkey to the East (Bowestead, 2007). In Poland, it is only known based on several plots that are located in six zoogeographical regions: the Masurian Lake Region, the Wielkopolska-Kujawy Lowland, the Białowieża Primeval Forest (Burakowski et al, 2000), the Małopolska Upland, Lower Silesia and the Świętokrzyskie Mts (Ruta, Gawroński, Jałoszyński, & Miłkowski, 2010). *Orthoperus nigrescens* has sporadically been observed in the all of its range. It inhabits deciduous forests in which the adults can be found under bark that is overgrown with mycelium, on mouldy piles of brushwood or in forest litter at the base of tree trunks (Burakowski et al, 2000).

***Sericoderus lateralis* (Gyllenhal, 1827)**

Libusza [EA10], 30.07.2014, at light, 2 exx.

Latridiidae Erichson, 1842

***Stephostethus alternans* (Mannerheim, 1844) ***

Bednarka [EA20], linden-oak-hornbeam forest (*Tilio-Carpinetum*), 12 .05.2015, 1 ex.

Stephostethus alternans is widespread in Europe (Johnson, 2007). In Poland, the species has been recorded only from four regions: the Wielkopolska-Kujawy Lowland, Lower Silesia, the West Sudetes and the Białowieża Primeval Forest (Biodiversity Map, 2018). It mainly inhabits rotten wood of various deciduous trees (especially *Quercus* and *Fagus*) (Burakowski, Mroczkowski & Stefańska, 1986c). This is the first record from the Eastern Beskidy Mts.

Tenebrionoidea Latreille, 1802

Mycetophagidae Leach, 1815

***Litargus connexus* (Geoffroy in Fourcroy, 1785)**

Libusza [EA10], scrubs, 15.05.2013, 1 ex.

Ciidae Leach, 1819

***Cis boleti* (Scopoli, 1763)**

Bartne [EV28], Carpathian beech forest (*Dentario glandulosae-Fagetum*), 11.07.2013, 1 ex.

Melandryidae Leach, 1815

***Osphya bipunctata* (Fabricius, 1775)**

Blechnarka [EV17], scrubs, shaken down, 21.05.2014, 1 ex.

The species has rarely been recorded in Poland, and therefore, it is only known from dozen or so dispersed localities in eight zoogeographical regions (Kubisz, Iwan, & Tykarski, 2014): the Pomeranian Lake District, the Wielkopolska-Kujawy Lowland, Lower Silesia, the Małopolska Upland, the Świętokrzyskie Mts, the Lublin Upland, the Roztocze Upland and the Eastern Beskid Mts. In the last mentioned region, it was previously found in Hołubla (Kubisz, Ruta, Jałoszyński, Konwerski, & Królik, 2010) and Prałkowce (Trella, 1923a). Adults are found on blooming shrubs (Kubisz et al, 2014). *Osphya bipunctata* is classified as a DD category species in the Polish Red List (Pawłowski, Kubisz & Mazur, 2002).

***Hypulus bifasciatus* (Fabricius, 1792)**

Libusza [EA10], 2008, 1 ex.

Zopheridae Solier, 1834

***Bitoma crenata* (Fabricius, 1775)**

Libusza [EA10], scrubs, 15.05.2013, 1 ex.; scrubs, shaken down, 20.05.2014, 1 ex.

Mordellidae Latreille, 1802

***Mordella holomelaena* Apfelbeck, 1914**

Bartne [EV28], meadow, 09.07.2013, 1 ex.; Libusza [EA10], scrubs, 15.05.2013, 1 ex.; Wysowa-Zdrój [EV17], meadow, 20.08.2010, 1 ex.

***Mordellistena humeralis* (Fabricius, 1758)**

Libusza [EA10], meadow, 27.07.2015, 1 ex.

***Variimorda villosa* (Schrank von Paula, 1781)**

Libusza [EA10], 22.07.2009, 1 ex.; 20.06.2005, 1 ex. Murkowa [EV39], scrubs, 13.06.2013, 1 ex.; Wysowa-Zdrój [EV17], meadow, 07.07.2010, 1 ex.

Tenebrionidae Latreille, 1802

***Allecula morio* (Fabricius, 1787)**

Libusza [EA10], scrubs, 20.07.2013, 1 ex.

***Allecula rhenana* (Bach, 1856)**

Libusza [EA10], synanthropic habitat, 12.07.2011, 1 ex.

***Bolitophagus reticulatus* (Linnaeus, 1767)**

Jaśliska [EV57], scrubs (*Rhamno-Prunetea*), 06.06.2015, 1 ex.; Wysowa-Zdrój [EV17], 27.08.2009, 2 exx.; 04.05.2014, 1 ex.

***Corticeus unicolor* Piller et Mitterpacher, 1783**

Wysowa-Zdrój [EV17], 27.08.2009, 1 ex.

***Isomira murina* (Linnaeus, 1758)**

Lipinki [EA10], shrubs, 15.06.2013, 1 ex.; subxerothermic plant community, 4.06.2015, 2 exx.

***Lagria hirta* (Linnaeus, 1758)**

Bartne [EV29], subxerothermic plant community, 09.07.2013, 4 exx.; scrubs, 11.07.2013, 3 exx.; Bednarka [EV29], 29.07.2014, 2 exx.; Krempna [EV38], scrubs, 11.08.2014, 1 ex.; Libusza [EA10], scrubs, 20.07.2013, 1 ex.; Lisów [EA21], mixed coniferous forest, 15.08.2014, 1 ex.; Wysowa-Zdrój [EV17], meadow, 23.07.2010, 1 ex.; wet meadow, 13.06.2011, 1 ex.

***Mycetochara flavipes* (Fabricius, 1792)**

Libusza [EA10], scrubs, shaken down, 20.05.2014, 1 ex.

***Opatrum riparium* Scriba W., 1865**

Dobrynia [EV39], subxerothermic plant community, 12.05.2015, 1 ex.

***Stenomax aeneus* (Scopoli, 1763)**

Bartne [EV29], pitfall trap, 11.07.2013, 1 ex.; Libusza [EA20] scrubs, 30.04.2013, 1 ex.

Oedemeridae Latreille, 1810

***Chrysanthia geniculata* Schmidt W.L.E., 1846**

Bartne [EV28], scrubs, 10.07.2013, 1 ex.; Kąty [EV39], scrubs (*Rhamno-Prunetea*), 22.07.2013, 1 ex.

***Oedemera femorata* (Scopoli, 1763)**

Dobrynia [EV39], subxerothermic plant community, 13.06.2013, 1 ex.; Libusza [EA10], 12.08.2009, 1 ex.; scrubs, 8.08.2013, 1 ex., 10.06.2013, 1 ex.; meadow, 16.06.2013, 1 ex.; Wysowa-Zdrój [EV17], meadow, 07.07.2010, 1 ex.; 23.07.2010, 2 exx., scrubs, 13.06.2011, 1 ex.

***Oedemera virescens* (Linnaeus, 1767)**

Libusza [EA10], 2003, 1 ex.; meadow, 15.05.2013, 1 ex.; scrubs, 30.04.2013, 1 ex., 10.06.2013, 1 ex. 15.05.2013, 4 exx.; Lipinki [EA20], scrubs, 30.04.2013, 1 ex.; Murkowa [EV39], scrubs, 13.06.2013, 1 ex.; Wójtowa [EA20], scrubs (*Rhamno-Prunetea*), 16.05.2013, 1 ex.; Wysowa-Zdrój [EV17], meadow, 23.07.2010, 1 ex.; scrubs, 17.05.2013, 1 ex.

Meloidae Gyllenhal, 1810

***Meloe proscarabaeus* Linnaeus, 1758**

Blechnarka [EV17], scrubs (*Rhamno-Prunetea*), 13.06.2011, 3 exx.

Pyrochroidae Latreille, 1807

***Pyrochroa coccinea* (Linnaeus, 1760)**

Libusza [EA10], 8.08.2008, 1 ex.

***Pyrochroa serraticornis* (Scopoli, 1763) (Fig. 3D)**

Libusza [EA10], 03.06.2010, 1 ex.; scrubs (*Rhamno-Prunetea*), 15.05.2013, 4 exx.; meadow, 10.06.2013, 2 exx.

This species is known in Poland from scattered sites, and it has usually been captured in small numbers. However, *P. serraticornis* is probably far more widespread than the scant literature data suggest. The species prefers riparian forests, which was

confirmed by our and Holly's (2010) observations. In the Eastern Beskidy Mts, it has been recorded four times (Kubisz, Iwan, & Tykarski, 2015).

***Schizotus pectinicornis* (Linnaeus, 1758)**

Bednarka [EA20], linden-oak-hornbeam forest (*Tilio-Carpinetum*), 16.05.2013, 2 exx.; 12.05.2015, 2 exx.; Libusza [EA10], 08.08.2008, 3 exx.; Wysowa-Zdrój [EV17], Carpathian beech forest (*Dentario glandulosae-Fagetum*), 17.05.2013, 4 exx.

Salpingidae Leach, 1815

***Salpingus planirostris* (Fabricius, 1787)**

Libusza [EA10], scrubs, 15.05.2013, 1 ex.; sieve analysis, 11.11.2014, 1 ex.

Anthicidae Latreille, 1819

***Anthicus antherinus* (Linnaeus, 1760)**

Wysowa-Zdrój [EV17], scrubs (*Rhamno-Prunetea*), shaken down, 30.04.2014, 1 ex.

Scraptiidae Mulsant, 1856

***Anaspis frontalis* (Linnaeus, 1758)**

Bednarka [EA20], linden-oak-hornbeam forest (*Tilio-Carpinetum*), 13.06.2013, 1 ex.; Dobrynia [EV39], subxerothermic plant community, 16.05.2013, 1 ex. Libusza [EA10], meadow, 10.06.2013, 1 ex.; Wysowa-Zdrój [EV17], scrubs, 17.05.2013, 1 ex.

Chrysomeloidea Latreille, 1802

Megalopodidae Latreille, 1802

***Zeugophora subspinosa* (Fabricius, 1781)**

Blechnarka [EV17], scrubs (*Rhamno-Prunetea*), 13.06.2011, 1 ex.; Dobrynia [EV39], subxerothermic plant community, 16.05.2013, 1 ex.; Wysowa-Zdrój [EV17], scrubs, 23.05.2011, 1 ex.

Curculionoidea Latreille, 1802

Curculionidae Latreille, 1802

***Dryocoetes autographus* (Ratzeburg, 1837)**

Małastów [EV18], wood pile, 14.06.2013, 1 ex.

***Hylastes ater* (Paykull, 1800)**

Libusza [EA10], 21.04.2014, 1 ex.

***Hylesinus varius* (Fabricius, 1775)**

Libusza [EA10], 24.07.2010, 2 exx.

***Ips cembrae* (Heer, 1836) ***

Wysowa-Zdrój [EV17], wood pile, pine, 02.05.2014, 1 ex.

Although this species has been recorded from eleven zoogeographical regions in Poland (Mokrzycki et al, 2011), it has not been recorded from the Eastern Beskidy Mts to date. Its host plants are *Larix* spp.

***Ips sexdentatus* (Börner I.K.H., 1766)**

Bednarka [EV29], 07.2004, 1 ex.

***Ips typographus* (Linnaeus, 1758)**

Blechnarka [EV17], wood pile, 20.08.2010, 2 exx.; Wysowa-Zdrój [EV17], 23.06.2010, 1 ex.; 23.07.2010, 1 ex.; wood pile, pine, 02.05.2014, 1 ex.

***Pityogenes bidentatus* (Herbst, 1784)**

Wysowa-Zdrój [EV17], wet meadow, 30.04.2014, 1 ex.

***Tomicus piniperda* (Linnaeus, 1758)**

Wysowa-Zdrój [EV17], wood pile, pine, 02.05.2014, 1 ex.

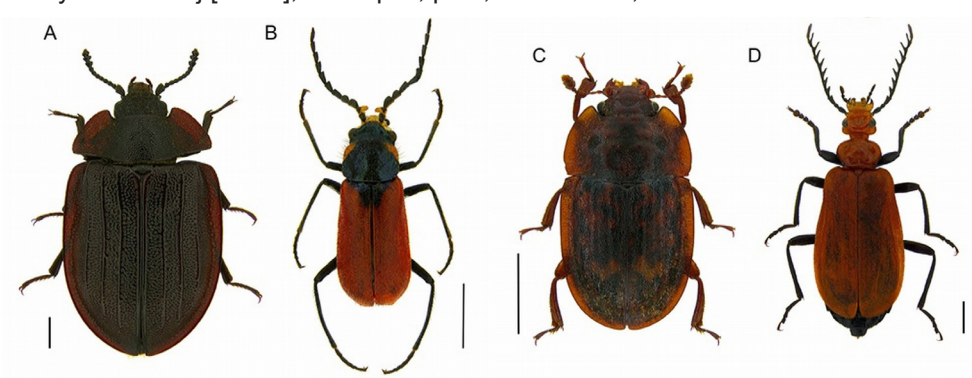

Fig. 3. A - *Peltis grossa* (Trogossitidae), B - *Malachius scutellaris* (Malachiidae), C - *Soronia punctatissima* (Nitidulidae), D - *Pyrochroa serraticornis* (Pyrochroidae); a linear scale - 2 mm.

DISCUSSION

Summary of the data presented in this paper

One hundred species belonging to 37 beetle families were found during our research studies. As many as 49 species were only represented by a single specimen and the next ten were only represented by two specimens. The estimated number of species that was calculated on this basis (Chao1 formula) was 220, which means that there are twice as many as have been recorded. Within the particular mesoregions, the following species were found: the Lower Beskids - 50, the Jasielsko-Krośnieńska Basin - 70 and the Ciężkowickie Foothills - 2 species.

Among the collected material, eight species were found in the Eastern Beskids for the first time: *Agabus congener*, *Dytiscus dimidiatus*, *Dolichosoma lineare*, *Amphotis marginata*, *Glischrochilus quadrisignatus*, *Orthoperus nigrescens*, *Stephostethus alternans* and *Ips cembrae*. Moreover, species that are rarely found in Poland, such as *Elodes johni*, *Lyctus pubescens*, *Peltis grossa*, *Malachius scutellaris*, *Soronia punctatissima*, *Osphya bipunctata* and *Pyrochroa serraticornis* deserve special attention.

Summary of the entire project: Coleoptera of the Eastern Beskid Mountains

Considering the entire research, which was conducted in the Eastern Beskid Mts, a total of 744 species from 63 beetle families have been found (Szczepański et al, 2013; 2015a; 2015c; 2015d; Szczepański, Taszakowski & Karpiński, 2014; Szczepański, Taszakowski & Karpiński, 2015b; Szczepański, Taszakowski, Karpiński & Kaszyca, 2016; Taszakowski, Szczepański, Baran & Morawski, 2014; Taszakowski, Baran, Kaszyca & Depa, 2015a; Taszakowski et al, 2017a; 2017b; 2018; Karpiński et al, 2015; Kaszyca & Taszakowski, 2017; Szołtys & Taszakowski, 2017). This constitutes approx. 12% of the Polish beetle fauna. The number of recorded taxa can be considered high, especially since representatives of the largest family Staphylinidae, which according to Szujecki (2017) comprises more than 1400 species in the country, constitute only a small part of the collected material. Only 49 species of this family were recorded during the sporadic samplings (Taszakowski et al, 2018). The estimated number of species that was calculated using the Chao1 formula for the entire project was 983 species, which is 233 more species than the number in our results.

Within the particular mesoregions, the following species were found: the Lower Beskids - 448, the Jasielsko-Krośnieńska Basin - 544 and the Ciężkowickie Foothills - 14 species. Forty-four species (approx. 6% of a total number) were recorded in the Eastern Beskids for the first time; among them as many as eight species (of the 49 collected in this family) belong to the family Staphylinidae. This proves an insufficient recognition of the staphylinid fauna of this region. The buprestids are even more poorly studied; of the 18 species that were collected as many as seven (approx. 39%) are new to the Eastern Beskids (Szczepański et al, 2015a). Moreover, one species - *Isorhipis nigriceps* (Mannerheim, 1823) (Eucnemidae) was recorded in Poland for the first time (Szołtys & Taszakowski, 2017). On the other hand, the state of knowledge on the beetles in this area is relatively high when this data is compared with the results of recent research on true bugs (Hemiptera). Among the 478 collected species of Hemiptera, as many as 175 (approx. 37%) were listed in this zoogeographic region for the first time and seven species were recorded as being new to the fauna of the country (Depa & Mróz, 2013; Taszakowski, Walczak & Baran, 2015b; Taszakowski, Walczak, Morawski & Baran, 2015c; Walczak, Taszakowski, Skrynetska & Kaszyca, 2016; Walczak, Kaszyca & Taszakowski, 2018; Depa, Mróz, Bugaj-Nawrocka & Orczewska, 2017; Kanturski, Mruk, Morawski, Wojciechowski & Depa, 2017; Kaszyca, Morawski, Taszakowski & Depa, 2018a; Kaszyca et al, 2018b; Taszakowski & Gorczyca, 2018).

Fifty-two species are protected by Polish law or are included in various lists of endangered species as follows: 1-strict protection, 2-partial protection, 3-Habitats

Directive (Annexes II and III) (EEC 1992), 4-Polish Red Data Book of Animals. Invertebrates (Głowaciński & Nowacki, 2004), 5-Red List Of Threatened Animals in Poland (Pawłowski et al, 2002), 6-The IUCN Red List of Threatened Species (IUCN 2003), 7-Carpathian List of Endangered Species (Pawłowski, 2003), 8-European Red List of Saproxylic Beetles (Nieto & Alexander, 2010). The red list category abbreviations are EN-endangered, VU-vulnerable, NT-near threatened, LC-least concern and DD-data deficient.

Allecula morio (Fabricius, 1787) [6] (LC)

Ampedus erythrogonus (P.W.J. Müller, 1821) [8] (LC)

Ampedus elongatulus (Fabricius, 1787) [8] (NT)

Ampedus melanurus Mulsant & Guillebeau, 1855 [5] (VU), [6, 8] (DD)

Ampedus pomorum (Herbst, 1784) [8] (LC)

Ampedus sanguineus (Linnaeus, 1758) [8] (LC)

Ampedus sanguinolentus (Schrank, 1776) [8] (LC)

Anaglyptus mysticus (Linnaeus, 1758) [8] (LC)

Aphodius scrutator (Herbst, 1789) [5] (LC)

Aromia moschata (Linnaeus, 1758) [7] (VU), [8] (LC)

Betarmon bisbimaculatus (Fabricius, 1803) [5] (EN), [7] (CR)

Callidium violaceum (Linnaeus, 1758) [8] (LC)

Carabus auronitens Fabricius, 1792 [2]

Carabus coriaceus Linnaeus, 1758 [2]

Carabus intricatus Linnaeus, 1761 [2, 5] (LC), [6] (NT)

Carabus irregularis Fabricius, 1792 [2, 5] (NT)

Carabus ulrichii Germar, 1824 [2]

Carabus variolosus Fabricius, 1787 [1, 3]

Ceruchus chrysomelinus (Hochenwarth, 1785) [2, 5] (VU), [6] (NT),[7] (EN/VU), [8] (NT)

Chlorophorus herbsti (Brahm, 1790) [8] (LC)

Claviger longicornis Müller, 1818 [5] (VU)

Clytus arietis (Linnaeus, 1758) [8] (LC)

Clytus lama Mulsant, 1847 [6, 8] (LC)

Cucujus cinnaberinus (Scopoli, 1763) [1, 3, 5] (LC), [6, 8] (NT)

Denticollis borealis (Paykull, 1800) [5] (DD)

Diachromus germanus (Linnaeus, 1758) [5] (NT)

Drypta dentata (Rossi, 1790) [5] (LC)

Elaphrus ullrichii Redtenbacher G., 1842 [5] (EN)

Emus hirtus (Linnaeus, 1758) [5] (NT), [7] (VU)

Eurythyrea austriaca (Linnaeus, 1767) [2, 5] (VU), [7] (EN)

Evodinus clathratus (Fabricius, 1792) [6] (LC)
Gnorimus nobilis (Linnaeus, 1758) [8] (LC)
Hylotrupes bajulus (Linnaeus, 1758) [8] (LC)
Isoriphis nigriceps (Mannerheim, 1823) [6] (DD)
Larinus sturnus (Schaller, 1783) [5] (VU)
Litargus connexus (Faucroy, 1785) [8] (LC)
Lixus punctiventris Boheman, 1842 [5] (VU)
Molorchus minor (Linnaeus, 1758) [8] (LC)
Monochamus sartor (Fabricius, 1787) [6, 8] (LC)
Monochamus sutor (Linnaeus, 1758) [8] (LC)
Obrium brunneum (Fabricius, 1793) [8] (LC)
Onthophagus illyricus (Scopoli, 1763) [5] (DD)
Oodes helopioides (Fabricius, 1792) [5] (VU)
Oryctes nasicornis (Linnaeus, 1758) [5] (NT)
Osphya bipunctata (Fabricius, 1775) [5] (DD)
Peltis grossa (Linnaeus, 1758) [5] (VU), [7] (EN)
Pidonia lurida (Fabricius, 1792b) [6] (LC)
Platycerus caraboides Linnaeus, 1758 [8] (LC)
Prionus coriarius (Linnaeus, 1758) [8] (LC)
Protaetia lugubris (Herbst, 1786) [8] (LC)
Pyrrhidium sanquineum (Linnaeus, 1758) [8] (LC)
Ropalopus macropus (Germar, 1824) [8] (LC)
Rosalia alpina (Linnaeus, 1758) [1, 3, 4] (EN), [5] (EN), [6] (VU), [7] (EN), [8] (LC)
Saperda perforata Pallas, 1773 [8] (LC)
Sinodendron cylindricum Linnaeus, 1758 [8] (LC)
Trichius fasciatus (Linnaeus, 1758) [8] (LC)
Tritoma bipustulata Fabricius, 1775 [6, 8] (LC)
Xylotrechus rusticus (Linnaeus, 1758) [8] (LC)

Many of the recorded species, primarily in the families Bostrichidae, Buprestidae, Cerambycidae, Cucujidae, Elateridae, Eucnemidae, Lucanidae, Lymexylidae, Nitidulidae, Ptinidae, Scarabaeidae, Silvanidae and Trogossitidae, belong to the group of saproxylic beetles. Some of them, the so-called *saproxylobionts*, are obligatorily associated with dead wood (e.g. *Ampedus*, *Agrilus*, *Anthaxia*, *Buprestis*, *Ceruchus*, *Chrysobothris*, *Cucujus*, *Denticollis*, *Monochamus*, *Nivellia*, *Oxymirus*, *Peltis*, *Platycerus*, *Rosalia*, *Sinodendron*, *Soronia*, *Stenocorus* and *Stictoleptura*), while others only facultatively associated - *saproxylophiles* (e.g. *Carabus*, *Chilocorus*, *Thanasimus* and *Tillus*). In this interesting and increasingly threatened group of insects, numerous species

are extraordinarily valuable from ecological point of view, and these are often referred to as *relict species* or *primeval forest species*. These include the rarest taxa, many of which are extremely vulnerable, especially in Europe. Although the definition of the *primeval forest species* is not yet unambiguous, among the collected material, the following taxa can certainly be included in this category: *Carabus intricatus*, *C. irregularis*, *Ceruchus chrysomelinus*, *Eurythyrea austriaca*, *Peltis grossa* and *Rosalia alpina*.

Among the studied habitats, the ecotone environments were characterised by the highest species diversity of beetles. These are habitats that are created at the junction of forests and meadows and in similar shrub environments, which are at various stages of succession. Although these plant communities are difficult to classify because of their considerable variation and mutual penetration, they can be placed in the class *Rhamno-Prunetea*, order *Prunetalia spinosae*, alliance *Pruno-Rubion fruticosi* and in the class *Trifolio-Geranietea sanguinei*, order *Origanetalia* and alliance *Trifolion medii* (Matuszkiewicz, 2013). Because of declining agricultural activities, such habitats are very common in the study area. Among the beetles that were recorded in the above-mentioned habitats, some species rarely collected in Poland were found, *inter alia*, *Omalisus fontisbellaquaei, Phosphaenus hemipterus, Osphya bipunctata, Malachius scutellaris* (these species are recorded herein)*, Scymnus suffrianioides apetzoides* Capra et Fürsch*,* 1967 (Szczepański et al, 2015c), *Agrilus sinuatus* (Olivier, 1790) (Szczepański et al, 2015b), *Phytoecia nigricornis* (Fabricius, 1781) (Karpiński et al, 2015), *Tachyerges rufitarsis* (Germar, 1821) (Taszakowski et al, 2017a) and *Cassida panzeri* Weise, 1907 (Szczepański et al, 2015b). Some species were collected only in the scrub biotopes and ecotone areas. This is probably connected with both the presence of a large number of suitable host plants and the specific environmental conditions, which permit the existence of helio- and thermophilic species. While such habitats play a big role as local biodiversity centres, unfortunately, they are often overlooked in faunistic studies.

Many species that have the southern type of range such as *Benibotarus taygetanus* (Pic, 1905), *Betarmon bisbimaculatus* (Fabricius, 1803), *Isorhipis nigriceps* (Mannerheim, 1823) and *Rhagonycha nigriceps* (Waltl, 1838) were found during the research (Szczepański et al, 2015d, 2016). Most probably, they came to Poland *via* passes in the Low Beskids. This path (the Ondavian migratory route) is a very important Transcarpathian route of migration for small fauna from the south to the north between the Pannonian Basin with the Ondava Upland and the drainage basin of the San and Wisłoka Rivers. For species that are characterised by a southern type of range, this route makes it possible to migrate to Poland and the effect of this migration is clearly visible in both the immediate vicinity of the passes in the Low Beskids and on the foothills of this mountain range (e.g. Szczepański et al, 2016; Taszakowski & Gorczyca, 2018). This issue is especially important nowadays in the era of the warming climate when this may be one of the most important routes for numerous species to cross the Carpathian Mountains and to extend their range to the north. Faunistic studies are necessary to follow the ongoing processes and transformations that are related to climate change, both dynamic (e.g. anthropogenic environmental transformations) and long-term (Banaszak, 2008; Gurung et al, 2009). Unfortunately, there is still not enough

research of this type, and it has become less and less supported by the government and scientific units. The state of knowledge, even in cases that involve the most valuable and best-preserved fragments of nature in Poland, is far from satisfactory (Banaszak, 2008). The invertebrate fauna of the Carpathians still requires a fundamental inventory in order to draw some solid conclusions on the species lists they belong on, their distribution and threats. The lack of knowledge of Carpathian invertebrate fauna is not an exception; this problem can be found all over the world (Pawłowski, 2003; Gurung et al, 2009). Unfortunately, the scientific policies that prevail in many countries not only do not support broadly understood ecological (especially faunistic) research, but on the contrary, they render them less profitable (Banaszak, 2008; Neff, 2018).

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